EKG CHANGES IN PULMONARY DISEASE

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What:
1. Review and reinforce what you already know.
2. Build a strategy and confidence in how to approach an abnormal EKG
3. Review some aspects of EKG that are troubling to some in the field.
4. Learn from a couple of unique situations.

What NOT:
1. A comprehensive review of all aspects of EKG. This would take more than our allotted time.

Legal/Financial: I am here for the satisfaction of knowing I made you better doctors, and the pure joy of being here today. I have nothing to sell you.
“The air goes in,
The air comes out,
The blood goes round and round…”
1. Rate
2. Rhythm (diagnostic)
3. Axis
4. Pathology

1. Rate
2. Rhythm (Regular/ Irregular…)
3. Origin of the Beat
4. Location of Pathology (P, PR, QRS, ST, …)
5. Axis
Garage (SA Node)

Yield Sign at on-ramp (AV Node)

Beach

Work
P = Atria
PR = AV Junction
Q = Septum
QRS = Ventricles (depolarization/down)
ST = Ventricular Latency (mm contraction)
T = Ventricles (repolarization/up)
The Electrical System of the Heart

- Sinoatrial (SA) Node
- Anterior Internodal Tract
- Middle Internodal Tract
- Posterior Internodal Tract
- Atrioventricular (AV) Node
- Right Bundle Branch
- Left Bundle Branch
- Conduction Pathways
- Bachmann's Bundle
- Q wave
- ST segment
- T wave
- R wave
1. Look at the computer read!
2. aVF/aVL Thumbs Up!
3. Isoelectric- Perpendicular
4. Most + Lead
“What is the most common diagnostic rhythm seen on EKG in a patient with pulmonary disease?”

“What is the most common diagnostic rhythm seen in ANY patient?”

Normal Sinus Rhythm!
“NORMAL SINUS RHYTHM” (SA NODE)

- Normal Rate!
- P for every QRS, QRS for every P
  - Proves Atrial
- Identical P waves
- Normal and consistent PR intervals
  - Proves same spot on Atria
- P waves upright in leads II, III, and aVF
Box count method - large boxes 300, 150, 100, 75, 60, 50

**Rate** = Normal, 64

P for every QRS, QRS for every P
Normal and consistent P’s and PR’s

**Normal Sinus Rhythm**
Rate: Fast
Rhythm: Just under 150
Origin of the beat: Regular
Sinus (atrial)

So, What is this?
Sinus Tachycardia
“When you see sinus tachycardia, do not think of a sick heart, but think of a healthy heart working in a sick body.”
Low Voltage:

COPD/Emphysema
Morbid Obesity
Myocardial Injury
Hypothyroid
Pericardial/ Pleural Effusion
Hypothyroid

The Rules:  QRS complexes (top of R to bottom of S)
Less than 5 mm (1 lg box) in all the limb leads
And/ or less than 10 mm (2 lg boxes)in all the precordial leads.
Hypoxia, Hypercapnia, Pulm. HTN, Vent overload, Atrial stretch, Inflammation, Pulmonary Rx
Hyperexpansion of the lungs:
Diastolic dysfunction

Hypoxic pulmonary vasoconstriction:
Vessels near hypoventilated alveoli constrict

Scarring and arteriosclerosis of the lungs:
Increased work of breathing

Pulmonary hypertension:
Increased pressure in R atria and ventricle

Changes in R heart lead to arrhythmia
Atrial changes - Think P waves!

Lungs -> R Atria
Rate: 9 beats in 6 seconds = 90
Rhythm: Irregularly Irregular!
Origin: What is that P’ish stuff?

So, what is this? A-fib!
>90% Irreg/ Irreg= A-Fib
Other 2
Multi Focal Atrial Tachycardia (MAT)
Wandering Atrial Pacemaker (WAP)
Normal P-wave
3 small square wide, and 2.5 small square high.
Always positive in lead I and II in NSR
Always negative in lead aVR in NSR
Commonly biphasic in lead V1
<table>
<thead>
<tr>
<th><strong>P -WAVE</strong></th>
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<tbody>
<tr>
<td><strong>P pulmonale</strong></td>
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<td>Tall peaked P wave. Generally due to <strong>enlarged right atrium</strong>—commonly associated with congenital heart disease, tricuspid valve disease, pulmonary hypertension and diffuse lung disease.</td>
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<td><strong>Biphasic P wave</strong></td>
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<td>Its terminal negative deflection more than 40 ms wide and more than 1 mm deep is an ECG sign of <strong>left atrial enlargement</strong>.</td>
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<tr>
<td><strong>P mitrale</strong></td>
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<tr>
<td>Wide P wave, often bifid, may be due to <strong>mitral stenosis</strong> or left atrial enlargement.</td>
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Wave Form Morphology
P-Wave

Right atrial enlargement
(= P Pulmonale)

The principal cause is pulmonary hypertension due to:
- Chronic lung disease (cor pulmonale)
- Tricuspid stenosis
- Congenital heart disease (pulmonary stenosis, Tetralogy of Fallot)
- Primary pulmonary hypertension
First degree heart block

P wave precedes QRS complex but P-R intervals prolong (>5 small squares) and remain constant from beat to beat.
Causes:
RVH/Cor pulmonale
Pulmonary embolus
R ischemic changes
Myocarditis
Rheumatoid heart
Congenital

Can be a normal variant
Normal EKG - Should NOT see prominent S waves in I, II, AND III

S1S2S3 Pattern = RVH
RVH:

R axis:

Prominent S waves in leads I, II, III (S1S2S3)

Can also see prominent S waves in V1V2V3: (SV1SV2SV3)
Multifocal Atrial Tachycardia (MAT)

- At least 3 different P wave morphologies
- Rate 100 to 180
- Irregular

**Etiology**
- Secondary to chronic lung disease (COPD)
- Hypoxia
- Pulmonary hypertension

**Management**
- Oxygen
- Treatment of underlying condition
- Rate control

EMS/ED-Mistaken as SVT (Rapid/Narrow QRS)
Atrial fibrillation

Atrial flutter

Multifocal atrial tachycardia

Irregularly Irregular!

A-fib!

MAT

WAP
Chou’s ECG criteria for COPD

- P-pulmonale
- P wave axis ≥ +80°
- QRS amplitude less than 5 mm in all limb leads
- QRS axis > +90°
- QRS amplitude less than 5 mm in V5, V6
- S1-S2-S3 pattern with R/S <1 in lead I, II, III
- Atrial arrhythmias (especially Multifocal Atrial Tachycardia or MAT)

• COPD is likely to be present if one P and one QRS criterion present
Sudden increase in pulmonary vascular resistance.
Acute R Heart Strain- R heart/ inf. heart
ST/T changes
S1Q3T3
Hypoxemia
Endorphins
S-waves in lead I
Q-waves in lead III
Inverted T-waves in lead III
Most common EKG change with PE= Sinus Tachycardia.

RBBB (complete or incomplete) common

R ventricular strain= T wave inversions
R chest (V1-4) and inferior leads (II,III, aVf)
Most sensitive= up to 99%

“Classic” Change= McGinn-White Change (S1Q3T3)
(only 10-20% of PE’s)
EKG & PE

- “S1 Q3 T3” - prominent S wave in lead I, Q and inverted T waves in lead III
- Right bundle branch block (RBBB), complete or incomplete, often resolving after acute phase
- Right shift of QRS axis
- shift of transition zone from V4 to V5-6
- ST elevation in VI and aVR
- generalized low-amplitude QRS
- sinus tachycardia, atrial fibrillation/flutter, or right-sided PAC/PVC
- T wave inversion in V1-4, often a late sign.
Normal Heart/ Sick Body
Normal Sinus Rythym
Sinus Tachycardia

Sick Chest
Low Voltage

Sick Heart/ COPD
A-fib
P-pulmonale
R axis deviation/ R Vent Hypertrophy
AV block/ RBBB
S1S2S3/ SV1-SV2-SV3
Multifocal Atrial Tachycardia

PE
Sinus Tach/R strain/ S1Q3T3